Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**DETERMINING THE COMPOSITION OF SATURATED SOLUTIONS AT VARIOUS TEMPERATURES**

Almost everyone is aware that a given solute will dissolve more readily in one solvent than another. Salt dissolves in water but not in gasoline; but gasoline is a better solvent for oil than is water. Even when a solute dissolves readily in a particular solvent, there generally is an amount beyond which no further solute can be dissolved. A solution which contains the maximum amount of solute in a given amount of solvent is termed "saturated." As the temperature of the solution is changed, the amount of solute which is required for saturation usually changes. Table G of your Chemistry Reference Tables shows how the solubility (amount required for saturation) varies with temperature for several typical compounds.

**Procedure**

1. Put on your goggles and lab apron. **Label four test tubes 1-4 with a marking pen. Place them in a test-tube rack.**

2. **Fill a 400-mL beaker three-fourths full of tap water, place a thermometer in it, and heat the water on a hot plate until its temperature is about 90°C.** CAUTION: *Do not touch the hot plate or heated water with your bare skin*. While you are waiting for the water to heat, go on to Steps 3 and 4.

3. **Place the following masses of potassium nitrate (KNO3) into the test tubes:**

2.0 g in test tube 1

4.0 g in test tube 2

6.0 g in test tube 3

8.0 g in test tube 4

4. **Add 5.0 mL distilled water to each test tube. Attach a utility clamp to a ring stand.**

5. **Place test tube 1 in the clamp and lower it into the hot water bath.** Stir the KNO3 solution with the stirring rod until the solid is completely dissolved. Remove the stirring rod and rinse it off. Loosen the utility clamp and, using a test-tube holder, remove the test tube and place it in the test tube rack.

6. **One lab partner should place the warm thermometer from the hot water bath into test tube 1 while the other repeats step 5 for test tube 2.**

7. **Watch test tube 1 for the first sign of crystallization and when it occurs, record the temperature in the Data Table. Remove the tube 2 from the hot water bath and repeat steps 6 and 7.**

8. **Repeat steps 5-7 for test tubes 3 and 4.**

9. **Place all the test tubes back in the hot water bath and redissolve the solid.** Flush the solutions down the drain with plenty of hot water. Turn off the hot plate. Clean up your work area and wash your hands before leaving the laboratory.

**Data Table for your Sample**

|  |  |
| --- | --- |
| **Test Tube** | **Temperature where crystallization occurs (oC)** |
| **1** |  |
| **2** |  |
| **3** |  |
| **4** |  |

**Calculations**

For each test tube, determine the solubility of KNO3 in grams per 100 g H2O.

\_\_mass of KNO3 = \_\_\_\_X\_\_\_\_

5 g H2O 100 g H2O

test tube 1:

test tube 2:

test tube 3:

test tube 4:

**Analysis and Conclusions**

1. On provided graph paper, construct a solubility curve for KNO3 by graphing the mass of KNO3 **per 100 grams H2O** (solubility) versus temperature. Place temperature on the x-axis and solubility on the y-axis. Connect the points in a smooth curve. Title your graph, and label your axis.

On the same set of axis, plot the KNO3 line that is on the solubility curve that I gave you in your notes. Listen to my directions to figure out how to do this.

Compare your results to those on the solubility curve in your notes: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. Describe the relationship between the solubility of KNO3 and the temperature of the solvent.

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3. Using your graph, determine how many grams of KNO3 can be dissolved in 100 g of H2O at the following temperatures:

35°C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

60°C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

70°C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Using your graph, predict whether the following solutions of KNO3 would be considered saturated, unsaturated, or supersaturated.

75 g KNO3/100 g H2O at 40°C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

60 g KNO3/100 g H2O at 50°C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. You just observed the relationship of temperature and the solubility of a solid, now think about the relationship of temperature and the solubility of a gas. In the space below, draw a set of axis and sketch the general shape for a solubility curve for a gas (hint: think of what would happen to pop as it gets warm). Label your axis, x-axis = temperature y-axis = solubility of a gas

6.) Define the following, feel free to use your textbook or notes

solubility: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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saturated solution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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unsaturated solution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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supersaturated solution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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7. A student stated that the solubility of potassium chloride, KCl, at 20°C was 36g of KCl per 100g of

solution. What is wrong with this statement?

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8. An unsaturated aqueous solution of NH3 is at 90oC in 100 grams of water. According to your solubility curve, how many grams of NH3, could this unsaturated solution contain?

a) 5 g b) 10 g c) 15 g d) 20 g

9. According to your solubility curve, which substance forms an unsaturated solution when 80 grams of the substance is dissolved in 100 grams of H2O at 10oC?

a) KI b) KNO3 c) NaNO3 d) NaCl

10.) Solubility data for four different salts in water at 60oC are show in the table below:

|  |  |
| --- | --- |
| **Salt** | **Solubility in Water at 60oC** |
| A | 10 grams / 50 grams of H2O |
| B | 20 grams / 60 grams of H2O |
| C | 30 grams / 120 grams of H2O |
| D | 40 grams / 80 grams of H2O |

Which salt is most soluble at 60oC? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11.) When 5 grams of KCl are dissolved in 50 grams of water at 25oC, the resulting mixture can be described as

a) Heterogeneous and unsaturated

b) Homogeneous and supersaturated

c) Homogeneous and unsaturated

d) Homogeneous and supersaturated

Explain your answer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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